which appeared in Griswold's Poets and Poetry of America (1842), and has been reprinted in Mr. Neill's histories. The last stanza but one has direct reference to the rock I have here first described, and runs thus:

> "Not long upon this mountain height
> The first and worst of storms abode,
> For, moving in his fearful might,
> Abroad the God-begotten strode.
> Afar, on yonder faint blue mound,
> In the horizon's utmost bound,
> At the first stride his foot he set;
> The jarring world confessed the shock.
> Stranger! the track of Thunder yet
> Remains upon the living rock."

——:o:——

VARIATION OF WATER IN TREES AND SHRUBS.

BY D. P. PENHALLOW.

THE amount of water which highly lignified plants contain, particularly as influenced by season and condition of growth, obviously bears a more or less important relation to physiological processes incident to growth, and most conspicuously to those which embrace the movement of sap. Studies relating to the mechanical movement of sap in early spring at once suggest the question as to how far this is correlated to greater hydration of the tissues at the time when this movement is strongest. It was with a view to exhibiting this relation more clearly, that determinations of moisture in a large number of woods, representing growth of one and also of ten years, collected at different seasons, were made in 1874.[1] The range of seasons was not as complete as could have been desired, and no attempt was made to formulate a general law applicable to this question. With a view to extension of data in this direction, additional estimates were undertaken in 1882, and it is the object of the present paper to combine all the results thus obtained, together with such other facts

[1] W. S. Clark. Agriculture of Massachusetts, p. 289.

as have come to our notice, and see how far they indicate a general law.

Theoretical considerations lead us to infer that if there is any variation at all, the hydration of structure must be greatest during the period of active growth, and least during the period of rest. How far this is supported by the facts will appear in what follows.

Hydration of Dead Wood.

Incidentally to the main question, specimens of dead wood, deprived of the bark and representing an age of from four to eight years, were collected and the moisture determined. While the branches were dead, none of them were in an advanced state of decay, so that the contained water could not be regarded as that of active decomposition, but simply that which would be readily retained in the lifeless, air-dried substance as exposed on the tree. The results obtained from fifteen species of trees showed an extreme variation of 6.1 per cent, the range being from 12.9 per cent to 19.0 per cent of water. The mean hydration obtained from these determinations was 15.1 per cent. The results appear in the following table:

HYDRATION OF DEAD WOOD.

Determined at 100° C.

Species.	*Per cent of water.*
Acer saccharinum	18.8
Amelanchier canadensis	19.0
Betula alba	15.1
" lutea	15.9
" lenta	13.7
Carpinus americana	13.8
Castanea vesca	14.0
Cydonia vulgaris	12.9
Cornus sericea	13.6
Pinus strobus	11.9
Pyrus malus	12.9
Prunus serotina	17.4
Quercus alba	15.5
Tsuga canadensis	18.6
Ulmus americana	13.5
Mean	15.1

Hydration of Wood from Living Trees.

The specimens upon which the principal facts in this paper are based, were collected as sections of living branches, representing on the one hand growth of two years, and on the other hand the growth of four years. For the obvious reason that the bark could not be properly separated from the wood with any degree of uniformity, it was left on in every case, so that in all the determinations here given the results show the combined percentage of water in wood and bark. Obviously this gives a result which differs materially from that which would be obtained if the wood and bark were considered separately. Also, while care was taken not to collect specimens in which the dead bark was strongly developed, thus securing as great uniformity as possible, the very fact that the bark was present, as well as the certainty of its variability in structural character, and thus also in hydration, as collected even from the same species at different seasons, rendered certain variations in the results unavoidable. This will doubtless appear upon examination of specific cases, but error from this source is reduced to a minimum in the aggregate, so that the mean results, in view of all the precautions taken, may doubtless be accepted as correct.

From an examination of the following results it will appear that, comparing the young growth with the older wood, the percentage of water is sometimes greater in one, sometimes greater in the other, conforming to structural peculiarities of the species and the relative preponderance of more or less strongly hydrated tissue. The mean results, however, clearly show what we might infer upon theoretical grounds, viz., that in the youngest growth, as also in the sap wood, the percentage of water is higher by two per cent than in the older growth, where the heart wood is in relative excess. This is found to hold true in the mean results not only for each season but also for all seasons; in the former case, however, the disproportion showing a variation from 0.8 per cent to 3.3 per cent.

	February.		March.		April.		September.		December.		Means.
	1st year.	2d year.	1st year.	2d year.	1st year.	2d year.	1st year.	2d year.	1st year.	2d year.	
Magnoliaceæ.											
Liriodendron tulipifera L.		55.8	52.7	54.9						59.3	44.5
Tiliaceæ.											
Tilia americana L.	55.1	53.9		55.6			48.6	55.9	53.2	58.1	54.3
Rutaceæ.											
Ailanthus glandulosus Desf.	48.6	46.0									47.3
Anacardiaceæ.											
Rhus glabra L.			45.6	41.1					41.2	36.4	41.1
" typhina L.			51.3								51.3
Vitaceæ.											
Vitis cordifolia Michx.	42.1	41.7	48.3	48.0					48.8	43.7	45.4
Ampelopsis quinquefolia Michx			59.2	60.7					76.4	62.4	64.6
Ilicineæ.											
Ilex verticillata Gray			46.2	46.4					48.0	49.4	47.5
Celastraceæ.											
Celastrus scandens L.			47.7	49.4					52.3	52.4	50.4
Rhamnaceæ.											
Ceanothus americana L.			17.3	37.6					19.5	41.4	28.9
Sapindaceæ.											
Acer saccharinum Wang.	46.5	47.1	47.5	42.9			48.1	44.0	42.6	42.7	45.2
" rubrum L.	44.9	44.7	50.8	45.4		48.7			53.0	55.1	48.9

Æsculus hippocastanum L.	49.1	46.1									47.6
" flava Ait.							64.9	65.4			65.1
Leguminosæ.											
Gleditschia triacanthus L.	34.9										34.9
Robinia pseudacacia L.			44.0	38.3					51.3		44.5
Rosaceæ.											
Amygdalus persica L.	46.1	40.4	50.9	49.4	56.0	43.7			55.3	42.0	47.9
Prunus domestica L.			48.1	41.2					53.9	46.2	47.4
" serotina Ehrhart			52.7	50.8			50.6	50.3	47.3	46.0	49.6
" cerasus L.			49.9						50.6	47.7	49.4
Cydonia vulgaris L.	45.5	39.6					56.3	52.6			48.5
Pyrus communis L.	49.9	47.7	49.7	48.1	55.4	54.0	54.0	51.5	53.7	50.0	51.4
" malus L.	49.5	44.8	45.7	41.5	49.0	46.4	56.2	54.5	48.3	59.	48.8
Amelanchier canadensis Torr. & Gray	44.3	38.0		44.6					47.4	45.1	45.9
Cratægus tomentosa L.			43.1	40.4					55.9	43.4	45.7
Hamamelaceæ.											
Hamamelis virginica L.	41.7	41.1	48.2	54.2					48.7	51.3	44.2
Cornaceæ.											
Cornus florida L.			55.1	43.2					53.6	52.8	51.2
" sericea L.			50.6	49.2			55.4		51.2		51.6
Nyssa multiflora Wang.	50.9	49.0	48.0	49.3			51.1	50.9	50.8	58.7	52.2
Caprifoliaceæ.											
Sambucus canadensis L.			58.2	48.2					56.3	55.1	54.4
" pubens Michx.	54.5	55.7									55.1
Viburnum opulus L.	44.7	47.7									46.2
Rubiaceæ.											
Cephalanthus occidentalis L.			54.1	42.8					42.8		46.6
Ericaceæ.											
Andromeda ligustrina Michx.			46.7	45.9					38.0	59.0	47.4
Kalmia latifolia L.		42.5	50.7	44.4					49.4	42.3	45.8
Azalea nudiflora L.			41.8	43.8					45.8	49.9	45.3

	February.		*March.*		*April.*		*September.*		*December.*		*Means.*
	1st year.	2d year.	1s year.	2d year.	1st year.	2d year.	1st year.	2d year.	1st year.	2d year.	
Oleaceæ.											
Fraxinus americana L.	32.0	29.6	38.3	34.4					35.2	29.5	33.2
Thymeleaceæ.											
Dirca palustris L.	51.8										51.8
Lauraceæ.											
Sassafras officinalis Nees.	34.9	33.9	40.7	38.1						41.4	37.8
Solanaceæ.											
Lycium barbarum L.									65.4	58.0	61.7
Urticaceæ.											
Ulmus fulva Michx			52.1	44.0					51.5	36.3	45.9
" americana L.	41.4	39.8	45.6	36.8			57.1	52.3	43.0	43.9	44.9
Morus alba L.	52.1	43.0									47.5
" rubra L.			47.0	42.8					56.2	40.9	46.7
Platanaceæ.											
Platanus occidentalis L.	44.5	57.6	50.2	52.1	52.5	53.8			48.2	50.6	51.2
Juglandaceæ.											
Juglans nigra L.	45.5	46.1	50.2	56.1					50.6	53.8	50.4
" cinerea L.			50.5	52.2			54.2	54.1	49.5	50.4	51.8
Carya alba Nutt.			39.2	40.2			45.7	45.1	38.4	37.8	41.1
" porcina Nutt.			40.8	38.0					38.1	35.4	38.1
" amara Nutt.	33.3	31.2									32.3

Cupuliferæ.											
Quercus alba L.	38.0	35.2	40.6	38.7	41.2	36.7	43.1	39.5	45.0	41.9	39.9
" bicolor Willd.			45.0						46.9		45.9
" coccinea v. tinctoria Wang.			42.5	38.0					44.9	39.3	41.2
" ilicifolia Wang.			40.6	39.4					42.2	38.4	40.4
" palustris Du Roi.			43.2	39.8					44.8	39.9	41.9
" prinus v. monticola Michx.			42.4	37.9					42.4		40.9
" rubra L.		34.3	42.6	38.6					41.7	39.9	39.4
Castanea vesca L.			47.4	45.6					45.1	44.5	45.6
Fagus ferruginea Ait.	44.2	44.7	45.4	45.7					45.2	45.8	45.2
" sylvatica v. purpurea.			43.8	43.3					43.7	43.5	43.5
Corylus americana Walt.			49.8	48.6					50.9	52.8	50.5
Ostrya virginica Willd.	37.6	38.6	43.0	36.5					44.4	44.5	40.8
Carpinus americana Michx.	38.7	39.4	45.6	42.8			51.7	48.7	44.5	43.9	44.4
Myricaceæ.											
Comptonia asplenifolia Ait.	40.6	40.0									40.3
Betulaceæ.											
Betula lenta L.			44.9	38.9					44.7	41.5	42.5
" lutea Michx.	42.4	43.6		38.2			49.7	49.4	44.4	42.5	44.5
" alba v. populifolia Spach.	46.2	42.0	41.1	37.7			53.9	48.5	45.0	39.1	44.4
Alnus viridis D.C.			47.9	43.2					48.9	55.0	48.8
" incana Willd.	50.4	51.5									50.9
Salicaceæ.											
Salix alba v. vittelina L.	49.9	51.7	55.5	55.5			53.1	49.7	55.4	55.5	53.3
Populus tremuloides Michx.	49.8	50.9	47.9	52.5			53.3	51.0	52.8	51.5	51.2
Coniferæ.											
Larix europea L.	40.9	47.8									44.3
Juniperus virginiana L.			57.6	45.9					56.2	45.1	51.2
Tsuga canadensis Carriére	48.7	49.6	46.8	49.9					44.1	45.6	47.4
Pinus rigida Miller.			54.2	52.3					53.8	57.6	54.5
" strobus L.			58.8	52.1	56.3	55.5	62.9	58.3	63.1	51.6	57.2

If we next inquire into the relation which seasons bear to the contained water, we will observe that the percentage continually rises from the mid-winter period until spring, and that it again falls from the close of summer to the mid-winter period. The extreme variations, as exhibited in our figures, show between February and September a difference of 8.4 per cent for the youngest growth and 7.1 per cent for that which is older.

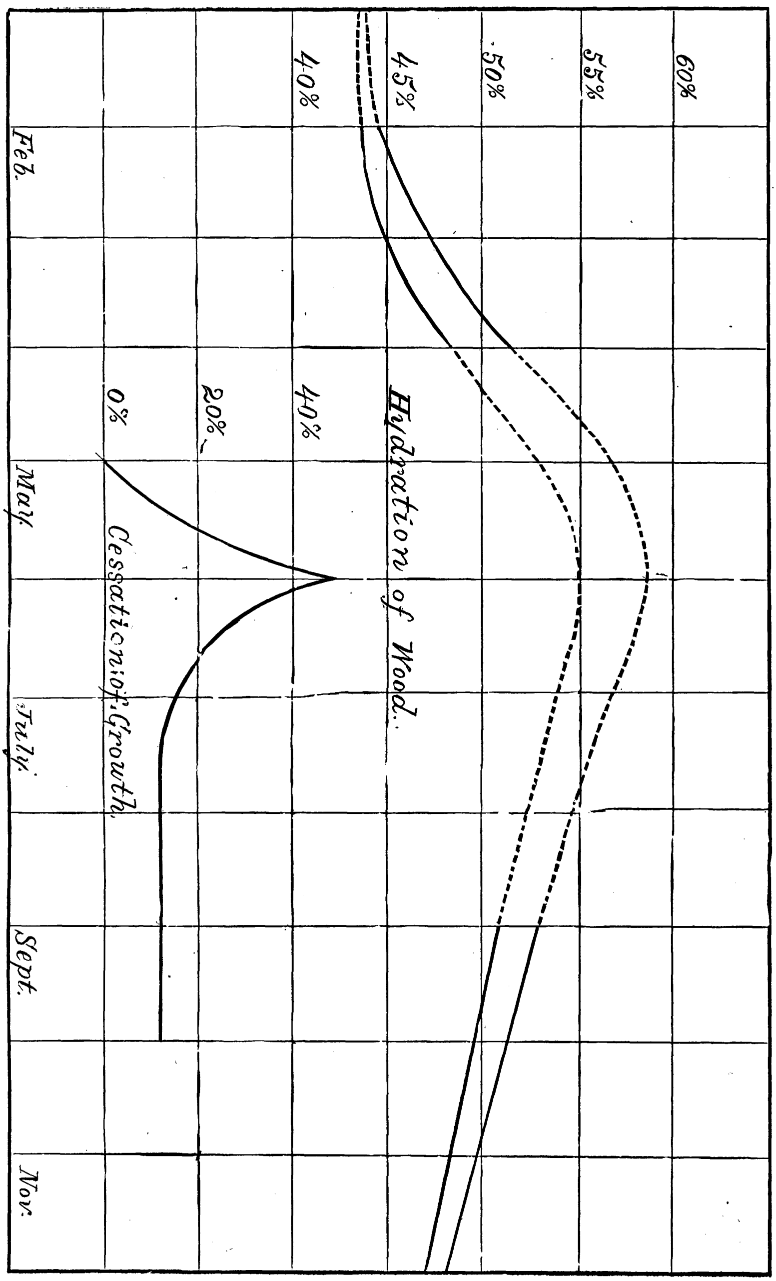
MEAN HYDRATION OF WOODS.

Determined at 100° C.

Months.	*Per cent water.*		*No. for average.*	
	1st year.	2d year.	1st year.	2d year.
February	44.7	43.9	37	38
March	47.2	44.8	59	60
April	51.7	48.4	6	7
September	53.1	51.0	19	18
December	48.3	47.2	61	58
	49.0	47.1	36.4	36.2

Our figures also indicate that the maximum hydration of the tissues must occur either in September, or at some period intermediate to this month and April. By graphic representation of these results, it will become possible to determine with approximate accuracy the true period at which this maximum is reached. The figures show that from February to April, the rate of percentage increase is much more rapid than the rate of percentage decrease from September to December, showing that the maximum must fall nearer the former than the latter period.

A properly constructed curve will show all of these relations. By reference to the accompanying diagrams it will be seen that the curves for both young and old wood run nearly parallel, but that they tend to approach at their greatest depression, or the mid-winter period, and to more widely separate at their greatest altitude, during the spring period. It is also seen that from mid-winter to spring, the curve rises rapidly, and reaches its greatest elevation about the last of May for the young wood, that which is older possibly reaching its maximum a few days later. From this time on the curve descends at a more gradual rate until December, when it suddenly drops to its minimum depression, which evidently occurs in January.


40%
45%
50%
55%
60%
0%
20%
40%
Hydration of Wood.
Cessation of Growth.
Feb.
May.
July.
Sept.
Nov.

Periods for Cessation of Growth.

As upon theoretical grounds the tissues contain most water when the growth is most active, data which will enable us to accurately fix the limiting periods for the season's growth, will have an important bearing upon this question. Mr. W. E. Stone,[1] accepting the completion of terminal buds as marking completion of the longitudinal growth for the entire year, has obtained the following data as establishing the limiting periods of growth for the latitude of West Point, N. Y., 41° 23′ N.:

JUNE 1ST.

Acer saccharinum Wang.
" *rubrum* L.
Amelanchier canadensis Torr. & Gray.
Carya alba Nutt.
Fagus ferruginea Ait.
Fraxinns americana L.
Hamamelis virginica L.
Kalmia latifolia L.
Populus tremuloides Michx.
Quercus alba L.
" *bicolor* Willd.
" *coccinea* Wang.
" *prinus* v. *monticola* Michx.
Sambucus pubens Michx.
Tilia americana L.
Ulmus americana L.
" *fulva* Michx.

JUNE 15TH.

Betula lenta L.
Carpinus americana Michx.
Castanea vesca L.
Juglans nigra L.
Lindera benzoin Meissn.
Morus rubra L.
Ostrya virginica Willd.
Prunus cerasus L.

JULY 19TH.

Andromeda ligustrina Muhl.
Alnus incana Willd.
Nyssa multiflora Wang.
Staphylea trifolia L.

INDETERMINATE PERIOD.

Ampelopsis quinquifolia Michx.
Celastrus scandens L.
Rhus sp.—
Vitis sp.—

Growth in length having ceased at these periods, the energy of the plant then becomes directed to the lignification of tissues and the deposition of reserve material for growth the following year. These changes, however, of necessity involve a continual decrease in the contained water. The data above also show that the majority of plants complete their longitudinal growth within the first six weeks of the growing season; that most of these complete their growth in from three to four weeks; and that, as the season advances, the number of plants still growing, rapidly diminishes until the middle of July, after which time there are left but few, those being plants like the grape, which continue to grow until arrested by severe cold.

Bull. Torrey Bot. Club, XII, 8, 83.

A graphic representation of these changes in connection with the curves of hydration, will enable us to determine the relation of growth and seasons to hydration of tissues. This comparison will show most conspicuously that that period at which growth for the season is chiefly terminated, is nearly coincident with the period of maximum tissue hydration, the former being but five or ten days later than the latter.

From the foregoing facts the following appear to be the general laws:

1st. The hydration of woody plants is not constant for all seasons, and depends upon conditions of growth.

2d. The hydration reaches its maximum during the latter part of May or early June, and its minimum during the month of January.

3d. Hydration is greatest in the sap wood; least in that which is older.

4th. Greatest hydration is directly correlated to most active growth of the plant; lignification and storage of starch and other products being correlated to diminishing hydration.

These facts apply only to latitudes lying between New York and Boston. For other latitudes, certain modifications might be necessary.

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DOMESTICATION OF THE GRIZZLY BEAR.

BY JOHN DEAN CATON, LL.D.

THE family of bears is among the most widely distributed groups of the quadrupeds, and is represented by a number of living species. They occupy the polar regions of the north and the temperate and torrid regions of both hemispheres. Some are of enormous strength and fierceness, others are diminutive and comparatively mild in disposition. Nearly every species has been held in captivity in considerable numbers, yet of their adaptability to domestication but little of real scientific value has been written, and I think I may add but little is known, for the want of judicious experiment and careful observation.

They are sometimes met with in the streets in various countries, exhibited by street showmen, who have taught them various amusing tricks, evincing considerable intelligence and docility,